COTSEN
TEXTILE TRACES
STUDY CENTER

2024

PROCEEDINGS OF THE
[RE]THINK SILK COLLOQUIUM

COTSEN
TEXTILE TRACES
STUDY CENTER

Proceedings of the [re]Think Silk Colloquium 2024

Selected Papers

Editors

John E. Vollmer

Karthika Audinet

GW | THE GEORGE WASHINGTON UNIVERSITY MUSEUM
THE TEXTILE MUSEUM

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The views expressed by the authors are their own. They do not necessarily reflect those of The George Washington University Museum and The Textile Museum.

Cover: (Full image above) Fragment of a chair drape (*yipi* 椅披), Chinese, seventeenth century, silk, slit tapestry weave, 27.90 × 38.70 cm (10 $^{31}/_{32}$ × 15 ¼ in.). Cotsen Textile Traces Study Collection T-1633. Photograph courtesy of The George Washington University Museum and The Textile Museum. Photo by Bruce M. White.

For special occasions reception room furniture was decorated with textiles, usually made in a set of three. Chair drapes "dressed" a pair of straight-back chairs; a table wrap (*zhuowei* 桌围) hung across the front a small table placed between the chairs. These silk textiles often featured figural patterns to be viewed from the front that were appropriate to the event — wedding, birthday, visit from a special guest. This fragment with stylized cloud bands would have hung down the back of one of the chair rails.

Frontispiece: Scholars at *[re]Think Silk* Colloquium workshop at the Cotsen Center, The George Washington University and The Textile Museum, April 10–11, 2024. Photograph by Denny Henry.

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Foreword

This publication is a record of the papers and workshops delivered at the Cotsen Textile Traces Colloquium, *[re]Think Silk*, which occurred in Washington, D.C., over two days in April 2024. The colloquium owes its existence to the imagination of the late Lloyd Cotsen, who amassed an extraordinary collection of textile fragments, and to the generosity of the late Margit Sperling Cotsen, who through the Cotsen Textile Traces Study Collection Endowment, entrusted its care to The George Washington University and The Textile Museum. The Cotsen Textile Traces Study Collection is vital to our museum and its commitment to object-based learning. Its continuing and active service to textile research and scholarship benefits a global network of textile scholars and inspires future generations of students and researchers.

In addition to the foundational support of the Cotsen trust, this project was made possible through another gracious act of philanthropy. Generous grant support from the Rubin–Ladd Foundation of New York supported the vision of our colleague John Vollmer, an accomplished scholar and a great friend to our museum. Our former Cotsen academic coordinator, Marie-Eve Celio-Scheurer, launched the Cotsen Colloquium as a global convening and initially worked with John Vollmer to host *[re]Think Silk*. Our current academic coordinator, Karthika Audinet, has provided dedicated stewardship of the Cotsen Textile Traces Study Collection and has been especially effective in engaging faculty, students, and visiting scholars. She has benefited from the support of our curatorial, conservation, collection management, advancement, and marketing and communications teams. The success of the Cotsen Textile Traces Study Center's programming is also due to the efforts of our museum education team, consisting of Lori Kartchner, Katrina Orsini, and Raneem Atiyeh. These dedicated professionals coordinated the participation of colloquium speakers from as far away as China, Italy, Russia, and across the United States, while also managing a virtual audience of many hundreds representing fifteen countries across five continents.

This audience and those who read these words online enable us to fulfill the vision of Lloyd and Margit Cotsen and the priorities of the Rubin–Ladd Foundation, as well as exercise the vast educational potential of our museum and university.

John Wetenhall, Director
The George Washington University Museum
and The Textile Museum

Acknowledgments

The Cotsen Textile Traces *[re]Think Silk* Colloquium evolved from a plan for an exhibition focused on new research affecting a wide range of issues concerning silk and sericulture. The scope expanded beyond the China-centric considerations of *Bombyx mori* to include the range of so-called wild silks from areas of Asia and Africa. Similarly, it looked beyond the conventional European and North American markets for silk.

Thanks to Ann Walzer, a generous grant from the Rubin–Ladd Foundation in New York supported the initial research that benefitted particularly from discussions with colleagues from China National Silk Museum, Boston Museum of Fine Arts, Philadelphia Museum of Art, Mactaggart Art Collection at the University of Alberta, and several independent scholars. We sincerely appreciate the time, consideration, and input from Janine Andrews, Nancy Berliner, Will Chandler, BuYun Chen, Bifen Chueh, Hiromi Kinoshita, Maria Menshikova, Michael Nylan, Mei Mei Rado; Hsueh-man Shen, Wang Shujuan, and Zhao Feng. Special thanks to Julie Segraves, director of the Asian Art Coordinating Council, for critical support and encouragement.

In early 2020, the idea was accepted by the Cotsen Textile Traces Study Center at The George Washington University Museum and The Textile Museum as the theme for a Cotsen Textile Traces Colloquium. Marie Eve Celio-Scheurer, the former academic coordinator of the Cotsen Center, helped develop the budget and the shape of the program and place it on The George Washington University Museum and The Textile Museum calendar for April 10–11, 2024. Planning for the *[re]Think Silk* Colloquium program was aided by an advisory committee, chaired by Lyssa Stapleton. Members included Sarah Fee, Sumru Belger Krody, Julie Segraves, Lee Talbot, Melinda Watt, and John Vollmer.

It takes a village to put together events like this. We would like to extend our special thanks to the staff at The George Washington University Museum and The Textile Museum. We are also grateful to student assistants Leehe Peleg and Marie Althaus for their help with running the colloquium.

The Cotsen Textile Traces Study Collection Endowment makes it possible for the Cotsen Textile Traces Study Center to serve as an incubator for textile research. The endowment supports the center's activities, including colloquia like this one, but it was a grant from the Rubin-Ladd Foundation to the George Washington University that brought the *[re]Think Silk* colloquium and this publication to fruition. The convening hosted seven panelists and five workshop presenters from six countries. This publication combines proceedings of both the public and the closed-door events over the two days. We are deeply grateful to all the participants. Three participants were unable to grant us permission to publish the content of their talks because of book contracts; we encourage you to search out those other publications. We are grateful to all of the colloquium participants for their research interest and their dedication to the future of textile studies.

John E. Vollmer
Karthika Audinet

PART 1

Sericulture and Applications in Science, Technology, and Art

Silvia Cappellozza

The *Bombyx mori* silk moth was domesticated from its wild progenitor, *Bombyx mandarina* (Fig.1 and Fig. 2).[1] Phylogenetic studies indicate that the silk moth has been the subject of significant human-driven selection and spread, which began approximately five thousand years BCE.[2] Now entirely dependent on human care for feeding and reproduction, the *B. mori* moth (Fig. 3) is unable to survive in nature. It is the sole fully domesticated insect.[3]

Spread of Sericulture

From its point of origin in Asia, the precious textile fiber produced by *B. mori* traveled for centuries to Europe via the "Silk Road," the famed network of overland Eurasian trade routes.[4] Sericulture, or the agricultural practice of rearing silk moth larvae, spread to Korea and Central Asia with Chinese expansion during the second century BCE. Sericulture was introduced into the Byzantine Empire in the sixth century,[5] and silkworm rearing subsequently spread throughout medieval Europe, with Italy and France becoming the principal silk-producing countries in the region. Additionally, several local silkworm strains (Fig. 4) and varieties of white mulberry trees (Fig. 5) have evolved throughout Europe as a result of the introduction of the plant from Asia.[6]

The white mulberry species (*Morus alba*) has been shown to be more resilient to cold winters than the black mulberry species (*M. nigra*), which was introduced to Europe from southwestern Asia at an earlier date. Consequently, the white mulberry is more adaptable to a range of European climates, exhibits faster growth, is more easily propagated by cuttings, sprouts earlier, and is richer in leaf protein. It is evident that the introduction of this species was instrumental in the development of sericulture in Europe. From the sixteenth to the nineteenth century, the quantitative expansion of mulberry

FIG. 1 (opposite)
Bombyx mori from the Laboratory of Sericulture, Padua, October 30, 2019. Photo by the author.

1 Sun et al. 2012, 484.
2 Yang et al. 2014, 185.
3 Xiang et al. 2018, 1268.
4 Liu 1998, 1-42.
5 Clare 1910, 1590.
6 Cappellozza, Saviane, and Toso 2013, 977.

FIG. 2
Bombyx mandarina from the Laboratory of Sericulture, Padua, October 3, 2024. Photo by the author.

FIG. 3
Silkworm rearing, private farm, Istrana, Treviso Province, Italy, May 28, 2018. Photo by the author.

FIG. 4
Cocoons from different strains of *B. mori* from the Laboratory of Sericulture, Padua, May 7, 2021. Photograph courtesy of the Serinnovation Operational Group, Padua.

FIG. 5
White mulberry tree, Valsugana, Trentino Province, Italy, September 12, 2022. Photo by Mattia Pasquazzo.

cultivation was accompanied by a growth in consumption, with silk representing one of the most prestigious symbols in many societies.

During the mid-nineteenth century, the pebrine crisis, caused by a microsporidium, or intracellular parasite, destroyed European sericulture, thus negatively affecting all silk industries. The recovery of European sericulture has been hindered by the emergence of Asian silks as a competitive force in global markets, initially from Japan and subsequently from China. Since the 1990s, China has become the dominant global producer of silk. Only countries with low labor costs have been able to hold their market positions; all other producing countries have become uncompetitive.[7]

Preserving Genetic Resources

To date, only two countries in Europe have succeeded in preserving their own silkworm genetic resources: Italy and Bulgaria. These resources consist of living collections of populations (races) of different geographical origins. All breeding lines have undergone extensive human selection, resulting in the hybrids used for commercial egg production. The silk moths reproduce at least once a year, and the characteristics of each generation of hatched larvae are constantly monitored.

Mulberry genetic resources are defined as living collections cultivated in fields at a gene bank facility. Mulberry species are represented by different groups of naturally evolved similar organisms, which have been further separated on the basis of human selection. Therefore, cultivated varieties are distinguished within different species. These vegetal accessions (*Morus* species and their cultivated varieties) are conserved in a certain quantity to ensure against the risk of a specific stock's being lost.

The above-mentioned animal and vegetal collections preserve the biological diversity of the silkworm and the mulberry at the genetic level (germplasm) and are the basis for further selection and conservation efforts. Compared to other European nations, Italy is the only country that possesses not only a silkworm and mulberry germplasm bank, but also a modest agricultural cocoon production and a thriving silk industry.

New Directions

A primary impediment to a wider resumption of sericulture in Europe has been the challenge of establishing a viable supply chain that would ensure silk farmers earn sufficient profits. Among the potential solutions to this challenge are the identifying and implementing of new applications and uses for the variety of byproducts that are generated in the process of producing silk.

Conventional silkworm-rearing only for their cocoons has dominated in most of the silk-producing countries, but the development of additional processes based on the utilization of silk byproducts offers promising avenues for sustainable agriculture.[8] An example of such a circular economic model is the processing of silk shells (the silk from the outer part of cocoons). These silk shells can be combined with suitable solvents to yield polymer solutions of silk proteins that can be re-formed using 3D printers (Fig. 6), or by using electrical force fields to draw out a continuous nanofiber with diameters ranging from nanometers to micrometers in a process called electrospinning.

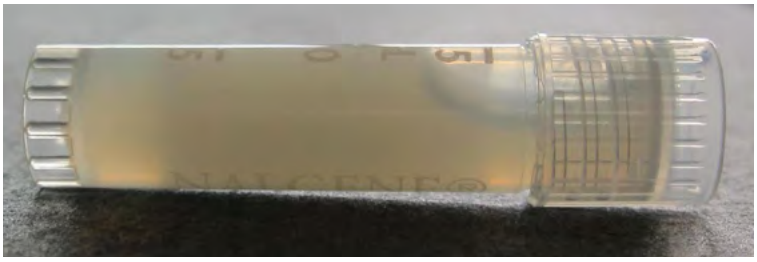

FIG. 6
Vial of fibroin solution produced by Caresilk, Puglia, Italy, April 28, 2017. Photograph courtesy of Caresilk.

7 Cappellozza et al. 2022, 44.
8 Cappellozza et al. 2022, 1016.

Other entirely novel applications have emerged as well in various industrial contexts, in such fields as regenerative design, cosmetics, biomedicine, and the sector of nanocomposites. These applications have enabled the production of innovative ligaments and bone tissues, vascular grafts and accesses, cell scaffolds, and nerve conduits (Fig. 7, Fig. 8, Fig. 9, and Fig. 10), all of which are fully compatible with and biodegradable within the human body.

Extremely sophisticated genome-editing experiments on *B. mori* have been conducted using the CRISPR/Cas9 methodology.[9] Some examples of successful genome editing, using either novel or traditional technologies, include the generation of silkworm strains resistant to a range of diseases and the production of fluorescent silk for biomaterial or fashion applications (Fig. 11).

There exists, as well, the potential for assessing the economic viability of the silkworm pupae, currently underutilized byproducts, in the feed and food industries.

Planning for the Future

Throughout human history few materials have had such an extensive and multifaceted presence as silk has had. It has been present in a multitude of contexts, and its heritage is intertwined with history and a variety of collective

FIG. 7
Silk used for vascular grafting, developed by KLISBio, Como, Italy, July 18, 2016. Photograph courtesy of KLISBio.

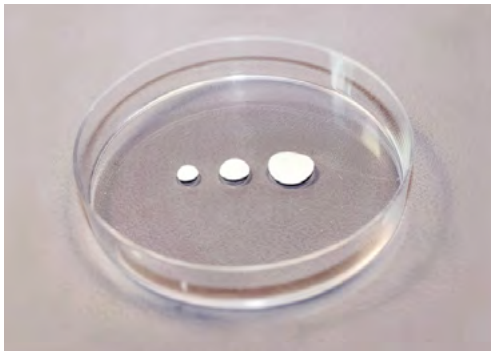

FIG. 8
Silk cellular scaffolds produced by Leonardino, Milan, October 1, 2013. Photograph courtesy of Leonardino SRL Italy.

FIG. 9
Three views of silk second skin produced by Leonardino, Milan, May 6, 2018. Photograph courtesy of Leonardino SRL Italy.

FIG. 10
Fibroin film produced by Caresilk, Puglia, Italy, April 28, 2017. Photograph courtesy of Caresilk.

9 CRISPR, an acronym for clustered regularly interspaced short palindromic repeats, is a gene-editing technology used selectively to modify the DNA of living organisms. See Bak, Gomez-Ospina, and Porteus 2018.

FIG. 11
Fluorescent silk, produced by National Agricultural and Food Organization (NARO), exhibited at the Twenty-seventh International Congress of Entomology, Kyoto, August 2024. Photo by the author.

cultural narratives. It is a significant conduit for both reflection and artistic creativity and design (Fig. 12, Fig. 13, and Fig. 14).

The ARACNE Project

The European Union's Horizon ARACNE Project was established to conserve and enhance knowledge of the tangible and intangible heritage of European sericulture and to encourage innovation by both cultural and creative industries.[10] The project is led by the Laboratory of Sericulture, based in Padua and was created in 2023 by CREA, which is the leading Italian research organization dedicated to the agri-food supply chains.[11]

FIG. 12
Martina Fontana, installation with cocoons and silkworm eggs presented at Maribor University, Slovenia, during the mid-term meeting of the ARACNE project (an acronym for Advocating the Role of silk Art and Cultural heritage at National and European scale), February 2024. Photo by the author.

10 The-ARACNE Project is an international consortium of agencies and businesses that aims to revive silk production by creating a resilient and innovative European silk ecosystem and to elevate the skills and competitiveness of Europe's silk-related cultural and creative industries. The name, based on that of protagonist of Greek mythology, is an acronym for Advocating the Role of silk Art and Cultural heritage at National and European scale. See https://aracneproject.eu/.

11 CREA is an acronym for Consiglio per la Ricerca in agricoltura e l'analisi dell'Economia Agraria (Council for Agricultural Research and Economics). It was established in 2015 by merging the Council for Agricultural Research (CRA) and the National Institute of Agricultural Economics (INEA). CREA operates under public law and is supervised by the Ministry of Agriculture, Food Sovereignty and Forests (MASAF).

FIG. 13
Evening wear designed by Yan Teng and Long Yue, from "The Axis of Time: Silk Clothing Fabrics from Suzhou" exhibition at the Museum of Palazzo Mocenigo, Venice, January to February 2024. Photo by the author.

FIG. 14
Eighteenth-century women's fashions exhibited at the Museum of Palazzo Mocenigo, Venice, February 7, 2024. Photo by the author.

FIG. 15 (opposite)
The Silk Pavilion Project II created by The Mediated Matter Group, The Massachusetts Institute of Technology, exhibited at the Museum of Modern Art, New York, 2020. Photo by the author.

ARACNE's overarching objective is to establish a silk-innovation ecosystem to trace the historical development of silk production and marketing in Europe and to construct a European Silk Route as a cultural itinerary. To achieve this, the project has formed a partnership of countries with a past connection to the historical Silk Road. Several stakeholders are involved, including research institutes and universities, cultural associations, museums, and small creative industries. The European Commission awarded a grant of approximately €3 million over three years to this diverse partnership. The project began in March 2023.

Virtual Mapping Initiative

The creation of a virtual map of points of interest along the European Cultural Silk Route is a key aspect of the ARACNE project. This interactive, digital representation aims to connect visually the various sites of silk heritage across Europe, providing a comprehensive view of the historical and cultural significance of silk production and trade. The map will be accessible via the project website, which provides access to a wealth of information, including scientific, historical, and artistic insights that can be consulted and downloaded. Key features of the virtual mapping concept include:

1. Interactive visualization of silk-related points of interest across Europe,
2. Integration of historical, cultural, and geographical data,
3. A scalable platform allowing for the continual addition of new sites and information,
4. A user-friendly interface accessible to both researchers and the general public,
5. The potential for integration with other digital resources, including the museum gamification system.

The virtual map will be designed to complement and integrate with other ARACNE initiatives to facilitate the process of cultural Europeanization by focusing on activities emphasizing European history, identity, and culture as expressed in both the tangible and the intangible silk cultural heritage and landscapes.

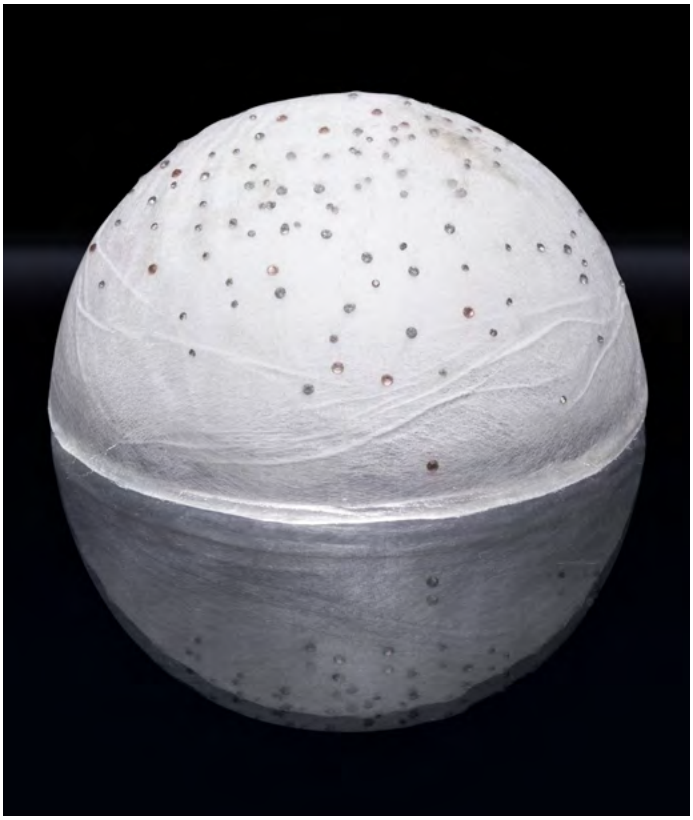

FIG. 16
Silk and gold jewelry, produced by D'orica, Nove, Italy, December 6, 2021. Photograph courtesy of D'orica.

FIG. 17
Spherical container made of non-woven silk produced by Sericyne in a patented process whereby instead of spinning cocoons, silkworms are placed on molds to produce objects of various shapes, Cévennes region of France, October 29, 2016. Photograph courtesy of Sericyne, Paris.

Germplasm Collections and Expanding Sericulture Practices

The ARACNE project also seeks ways to support local sericulture by studying and applying models that encourage and sustain local silk-built heritage and landscapes, and by developing business, governance, and financing models that will sustain them. By identifying the various mulberry tree varieties that have been preserved in germplasm collections across Europe, it hopes to encourage the creation of mulberry preservation sites in each country, with the aim of ensuring the availability of genetic material for future sericulture development.

The recreation of historical agrarian landscapes characterized by mulberry cultivation is also a key objective. Another is the selection, from local collections, of typical silkworm strains that can be used to recreate traditional silk products, with distinguishable characteristics. In this context, analysis of historical cocoons in the museums participating in the project is vital to reconstructing phylogenetic relationships among the cocoons and providing historical narrative.

Once the plants and worms have been reproduced and selected, they will be made available to European farmers to produce local silk and a range of byproducts, including fiber, cellulose, biomedicals, fruits, feed, and supplements.

Through the implementation of multiple case studies on silk and its associated industries, the project also seeks to create new paradigms of economic development. These case studies will encompass the development of new technological products both for the cultural industries, such as museums, and for the start-up (Sericyne) and creative (D'orica) companies involved in the project, which will specialize in furnishings and design objects (Fig. 15, 16 and Fig. 17).

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Appendix B: Colloquium Presenters

Karthika Audinet is a textile designer, educator and researcher with thirty-two years of experience. She has worked in India, Cambodia, Brazil, France, and the United States. Since 2023, she has served as the Academic Coordinator of the Cotsen Textile Traces Study Center at The George Washington University Museum and The Textile Museum in Washington, D.C. Audinet holds master's degrees in textile design from the National Institute of Design in India and the École Nationale Supérieure de Création Industrielle in France.

Silvia Cappellozza is the Research Manager responsible for the Sericulture Laboratory at the Council for Agricultural Research and Economics, Agriculture and Environment Research Centre, Padua. She has thirty years of experience in silkworm rearing and breeding, is a qualified teacher of entomology and pathology, and collaborates with other organizations to train aspiring silk farmers. She has published more than fifty articles, serves on the editorial board of three international journals, and has obtained a number of industrial patents.

Zvezdana Dode is the Chief Researcher, Nasledie Foundation, Stavropol. Her research focuses on medieval dress and textiles of the North Caucasus and Central Asia and on international trade. She is the author of more than seventy articles on textiles and costumes of the northern Caucasus, including those found in the Golden Horde graves in the interfluves of the Don and Sal rivers.

Sarah Fee is Senior Curator, Global Fashion & Textiles at the Royal Ontario Museum. Her research interests include woven and printed textiles, textile trades, cross-cultural appropriations of cloth and dress, ceremonial exchange, spinning and dye technologies, and the history of museum textile collecting. She is a Chercheuse Affiliée at the Musée du Quai Branly (Paris), a Research Associate at the Indian Ocean World Centre (McGill University), a Senior Fellow of Massey College, and serves on the editorial board of *The Textile Museum Journal*.

Mariachiara Gasparini is Assistant Professor of Chinese Art and Architectural History at the University of Oregon. She has written extensively on Chinese and Central Asian textiles, material culture, wall painting, and artist practices focusing on Sino-Iranian and Turko-Mongol interactions. Her most recent research has centered in Tuyuhun and early Tibetan material culture across Qinghai and Sichuan provinces and the trans-Himalayas.

FIG. 1 (opposite) Scholar at Zhao Feng's *[re]Think Silk* Colloquium workshop at the Cotsen Textile Traces Study Center, April 10, 2024. Photo by Denny Henry

Sylvia Houghteling is an Associate Professor of the History of Art at Bryn Mawr College. Her research has concentrated on early modern visual and material culture, focusing on the history of textiles, South Asian art and architecture, and the material legacies and ruptures of European colonialism. Her book *The Art of Cloth in Mughal India* (Princeton University Press, 2022) won the Charles Rufus Morey Book Award from the College Art Association and the R. L. Shep Memorial Book Award from the Textile Society of America.

Jonathan Mark Kenoyer is one of the world's leading authorities on the ancient Indus civilization. A Professor of Anthropology at the University of Wisconsin–Madison, he has been excavating with the Harappa Archaeological Research Project (HARP) at the ancient Indus city of Harappa since 1986. His interests include the origins of cities, writing, and technology. He has worked with craftspeople in both Pakistan and India to replicate ancient pottery, jewelry, and other objects.

Laia Mogas-Soldevila is an Assistant Professor of Graduate Architecture and Director of DumoLab Research at the Stuart Weitzman School of Design, University of Pennsylvania. Her research focuses on new sustainable material practices bridging science, engineering, and the arts. She is a licensed architect with a minor in fine arts.

Richard S. Peigler is Professor of Biology at the University of the Incarnate Word in San Antonio, Texas. His research is on the systematics and ecology of moths of the worldwide family Saturniidae, with a focus on those in North America and eastern Asia. He has studied wild silks in Japan, India, China, South Africa, and Madagascar. He has authored or co-authored books, book chapters, and numerous articles on the Saturniidae and wild silks.

Elena Phipps worked at the Metropolitan Museum of Art for thirty-four years as a textile conservator and was co-curator for two major textile exhibitions. She has published widely on the indigenous textiles, textile technologies, and cultural exchanges in the Americas. Since 2011, she has taught textile history, techniques, and cultures in the Department of World Arts and Culture/Dance, University of California at Los Angeles (UCLA).

Giorgio Riello is Professor of Early Modern History at European University Institute (EUI), Florence, and Professor of Global History and Culture at the University of Warwick, UK. He has published extensively on the history of material culture, trade, and consumption in early modern Asia and Europe, and has authored and co-edited numerous books. He is currently directing a large-scale research project considering the system of trade within the Indian Ocean region. The paper delivered by him is included in the book: Dagmar Schäfer and Giorgio Riello, In Times of Wealth: Silk and Innovation in China and Europe (Princeton: Princeton University Press, forthcoming 2026).

Karen Selk is a textile artist, educator, researcher, and writer with a deep love and understanding of wild silk. Along with her husband Terry Nelson, she founded Treenway Silks, a silk fiber and yarn import/export company in 1978. She has spent the past forty-five years researching and working with wild silk producers in the eastern provinces of India.

John E. Vollmer is an independent scholar, curator, and museum consultant. He has taught at universities in Canada, the United States, Germany, and Taiwan. He is the author of forty museum exhibition catalogues and numerous academic and popular articles on Chinese dress, contemporary art textiles, and a variety of decorative arts. He served as the editor for the East Asia volume of the ground-breaking ten-volume *Berg Encyclopedia of World Dress and Fashion* (Berg Publishers, 2010).

Zhao Feng is the dean of the School of Art and Archaeology at Zhejiang University and the honorary director of the China National Silk Museum (CNSM) in Hangzhou. He is also a member of the Executive Board of the International Council of Museums (ICOM) and president of the International Association for the Study of Silk Road Textiles (IASSRT). He has authored and edited numerous books. His research focuses on textile archaeology and conservation, museology, and the history of silk art along the Silk Roads.